HIGH-PERFORMANCE BRAKE SYSTEMS

DESIGN, SELECTION AND INSTALLATION

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Front Cover:
There is more to upgrading your brake system than just shopping for the best looking parts. While aesthetics certainly are important, consideration must also be given to system-level performance. Picking the right parts is usually more complicated than physically bolting them on–they have to work together. (Randall Shafer)

Title Page:
During track use, rotors are squeezed with thousands of pounds of clamp force, twisted by thousands of foot-pounds of torque, and heated to over 1,200 degrees F. Heavy cars with large engines such as these only make the demands that much more intense. (Wayne Flynn/pdxsports.com)

Back Cover, Top:
Designing a hot rod brake system from scratch may seem intimidating at first, but the fundamental concepts of gain and balance still apply. What really differentiates these brake systems are unique design and operating requirements that may require different compromises than would be appropriate for an all-out racecar. (Randall Shafer)

Middle:
Because experience is the best teacher, the final four chapters of this book are dedicated to sharing our years of upgrade know-how with you. Whether you are upsizing your front rotors for track use or converting your muscle car from rear drum brakes to rear disc brakes, grab your wrenches and head out to the garage with us. Just be sure to wear your safety glasses! (Randall Shafer)

Bottom:
Motorsports can place extreme demands on your brake system, and if your hardware is not up to the task, performance can suffer dramatically. A solid understanding of brake system fundamentals greatly increases your likelihood of ending up in the winner's circle on race day. (Wayne Flynn/pdxsports.com)

CHAPTER 14

HOT ROD BRAKE UPGRADE

In many ways, hot rod builders are on their own when it comes to brake system component selection and system design. Unlike any of the production-based brake upgrades discussed this far, building a hot rod from scratch (or even from a kit) entails a unique collection of brake system considerations and constraints. With custom frames, powerful drivelines, modified bodies, and cut-and-paste suspension systems, there is little opportunity to learn from the original vehicle when the time comes to create your own hot rod brake system.

Yet the laws of physics still apply in these applications, making basic brake system design criteria just as important here as they were in Chapters 11, 12, and 13. The pages that follow will expose you to some of the most common design compromises, hardware considerations, and installation pitfalls that are either unique to, or exaggerated by, hot rod brake systems.

We were fortunate to catch this 1940 Ford hot rod pickup in the middle of its own brake upgrade project. When embarking on your own hot rod brake system upgrade, it sure helps to have the vehicle up off the ground in a clean and well-lit garage. If possible, having most of the body and powertrain out of the way makes the job that much easier. (Randall Shafer)

The Vehicle

The subject of this hot rod brake upgrade project began life as a 1940 Ford pickup truck. Although it still possesses some token bits of the original body and frame, little else resembles what rolled off of the assembly line over 60 years ago. Custom roadster coachwork, independent front suspension, Chevy power under the hood, and a host of complex chassis changes only begin to describe the level of change this truck has experienced.

Although originally equipped with hydraulic brakes (mechanical brakes were only dropped the year before in 1939), the single-circuit master cylinder and four-wheel drum brake layout was dated at best. Therefore, as long as the rest of the truck was being significantly modified and updated, the brake system was upgraded as well.

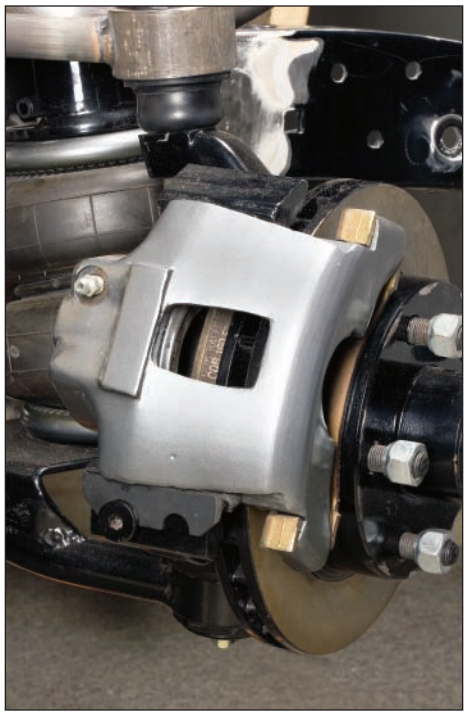
The Objective

Like most vehicles of this type, this hot rod was primarily designed for cruising along on a Sunday afternoon drive. Therefore, increased thermal capacity was not high on the list of needs or wants. At the same time, optimizing brake pedal feel was not critical for the truck's intended use. In short, the most important brake system performance requirement was to slow the truck in a stable fashion during emergency-type events. Naturally, the parts had to look good (since that's a big part of what hot rodding is all about), but performing a single stop quickly and reliably from a moderate speed was the most stringent brake system performance design target.

Front Brake Upgrade

The forward frame rails of the truck had already been modified to accept one of the most common independent front

It took a significant amount of modification to adapt a Mustang II front suspension to the stock front frame rails. However, the front brake hardware remains essentially unchanged from the Mustang II design. Note that many hot rodders upgrade their Mustang II front end with a set of 11.0-inch diameter rotors and aftermarket caliper mounting brackets. (Randall Shafer)



The Mustang II front brake calipers contain relatively large brake pads held in place by floating caliper bodies. The single piston in each caliper was designed to be offset relative to the center of the rotor friction disc, resulting in a larger effective radius. In plain English, this means higher gain is possible in a smaller package. (Randall Shafer)

suspensions used in the hot rodding community. Lifted straight from a Ford Mustang II, this setup can be found hanging off the front end of countless hot rods today. In this application, the upper and lower control arms had already been replaced with custom tubular pieces, but the front uprights, bearings, and brake hardware were straight from the Ford parts bin.

Chosen more for availability and fitment than for thermal mass and effective radius, the front rotors measured a relatively small 9.0 inches in diameter and 0.9 inches in thickness. Although the straight vanes in the vented friction discs were not expected to be as efficient as curved vanes would have been, any front rotors would be more thermally robust that the stock front drums.

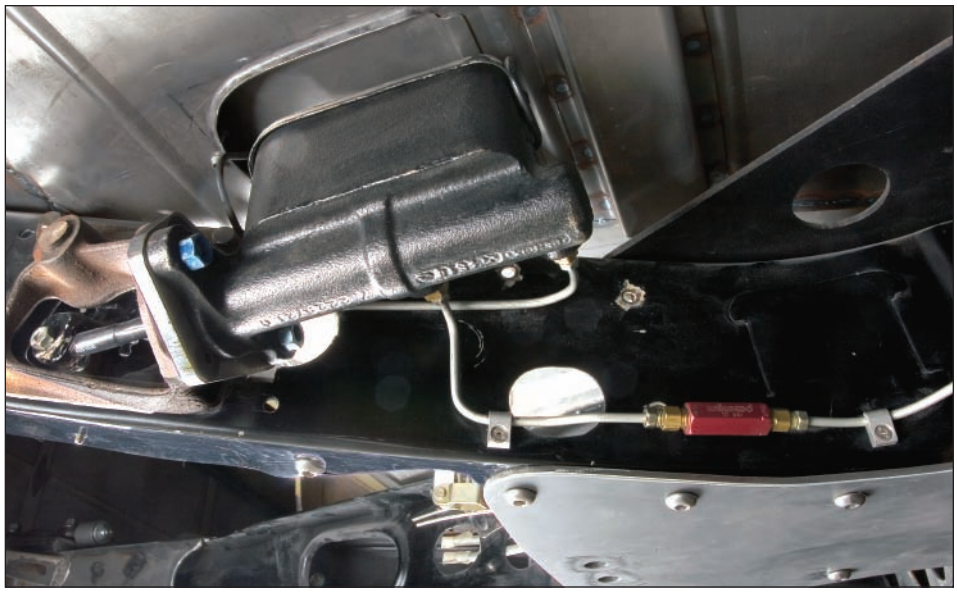
Like the front rotors, the front calipers were chosen more for convenience than for performance. These remanufactured single-piston calipers were based on the original Mustang II floating design. Their compact dimensions were the final consideration, as this would lead to flexibility in wheel selection later in the project.

Although a more modern Ford rear axle had been installed, in the interest of both time and money it was decided to leave the rear drum brakes in place. Of course they would receive a fresh coat of paint and fresh internal components, but with so little weight over the rear tires there was no reason to improve their performance. Even though it was still a pickup truck, its heavy hauling days were over.

Brake Pedal Considerations

In 1940, vacuum boosters were still several decades away from becoming mainstream brake system components. Therefore, because the truck was originally built without a vacuum booster (in other words, built with manual brakes), the brake pedal ratio was exceptionally high compared to conventional standards. Employing a pedal ratio of approximately 8.0:1, the stock brake pedal was required to swing through a relatively long arc as brake pressure was generated in the master cylinder.

Since the truck's master cylinder was originally mounted beneath the floor of the vehicle, retrofitting a vacuum booster,



While the stock single-circuit master cylinder was swapped for a tandem unit, its location under the vehicle was retained. The tight confines dictated that an opening be cut in the floorpan to allow access to the brake fluid reservoir. Check out the elegant routing of the custom-bent brake lines! (Randall Shafer)